Major Programs Sector

Prepared for

**NASA Glenn Research Center**

Microgravity Science Division

Cleveland, OH 44135

Microgravity Research, Development and Operations Contract

(MRDOC)

Contract No.: NAS3-99155

# PERFORMANCE MANAGEMENT PLAN

(DID No.: CD-01)

May 10, 2000

Prepared by:

Federal Data Corporation

3005 Aerospace Parkway

Cleveland, OH 44142

The Performance Measurement Plan is approved for use by the MRDOC Team:

Dr. Guion S. Bluford
MRDOC Program Manager
Vice President
Federal Data Corporation

5/25/01

Stephen N. Simons
Deputy Chief
Microgravity Science Division
NASA Glenn Research Center

TABLE OF CONTENTS
PERFORMANACE MEASUREMENT PLAN

TABLE OF FIGURES
PERFORMANACE MEASUREMENT PLAN

**Figure** **Title** **Page**

# 1.0 Introduction

This Performance Measurement Plan is submitted in response to the requirements of NASA contract NAS3-99155, DID No.: CD-01. The Performance Measurement Plan will describe the structure and contents that will be utilized to document the current status of MRDOC activities. The plan will discuss specific performance measurement metrics, the processes used to develop them, and how they will be used to manage MRDOC.

## 1.1 Plan Development Requirements

As stated in DID No.: CD-01 the plan will address how the fixed price and cost portions of the contract will be reported. Separate monthly performance reports will be provided for the FCF and each Delivery Order. The date of submittal will be on each report. The plan will list each report, the number of copies to be submitted and the process used to develop the reports. At a minimum, the monthly Performance Measurement Reports will consist of:

A) Schedules: i) Project Milestone Schedule, ii) System Level Schedule, iii) Major Concept Level Schedule
B) Technical Accomplishments organized by appropriate WBS level
C) Near Term Activities organized by appropriate WBS level
D) Problems/Issues/Risks/Mitigation Strategies organized by the appropriate WBS level.

## 1.2 Metric Reports

The Performance Measurement Plan will identify a list of metrics that will be used by the FDC to daily manage MRDOC activities. Submitted reports will include a definition, source of data, computation approach, desired outcome, frequency of reporting and period of measurement.

All financial reports will be submitted in accordance with NPG 9501.2C (ref. NASA Form 533 reports)

# 2.0 Scope

The Performance Measurement Plan is applicable to all FDC and subcontractor team activities in support of MRDOC and related delivery orders and options. All Functional managers on the FDC MRDOC Team will be given a copy of the plan and briefed on its contents.

The Performance Measurement Plan is based on industry best practices for bringing project management discipline to MRDOC. As a teaming partner with FDC, Robbins-Gioia will establish and sustain an effective business and project management planning and control architecture for MRDOC. The Performance Measurement Plan will discuss the project management processes and set forth the requirements for team members to enable effective collection and use of MRDOC performance measurement metrics.

# 3.0 Organization Structure

## 3.1 Roles and Responsibilities

See Figure 1. The organization clearly divides responsibilities and authorities to focus on the development of specific products. Single points of responsibility and accountability are established for the FCF, ISS integration and TSC operations, and PI experiments. Each FCF rack and each Exhibit 2 and Exhibit 3 DO has a Project Manager with cost, schedule, and performance responsibility and the authority to plan and manage the day-to-day performance of the project.

## 3.2 Teaming and Subcontracting

See Figure 2. FDC teaming partners are proven NASA performers, having executed contracts with similar requirements at GRC, GSFC, JSC, MSFC, and KSC. In addition, four partners are small businesses that have demonstrated the same responsiveness and dedication that have characterized FDC's prior relationships with GRC.

In the area of Program Planning and Control, FDC has teamed with Robbins-Gioia, Inc (R-G). R-G was selected for its extensive government and commercial project management experience and proven systems (CAT II). R-G has developed and implemented the MRDOC Information Management System (MIMS) which enables the FDC Team to manage MRDOC through performance measures using an integrated business systems approach.

**Figure 1 FDC MRDOC Program Organization.**

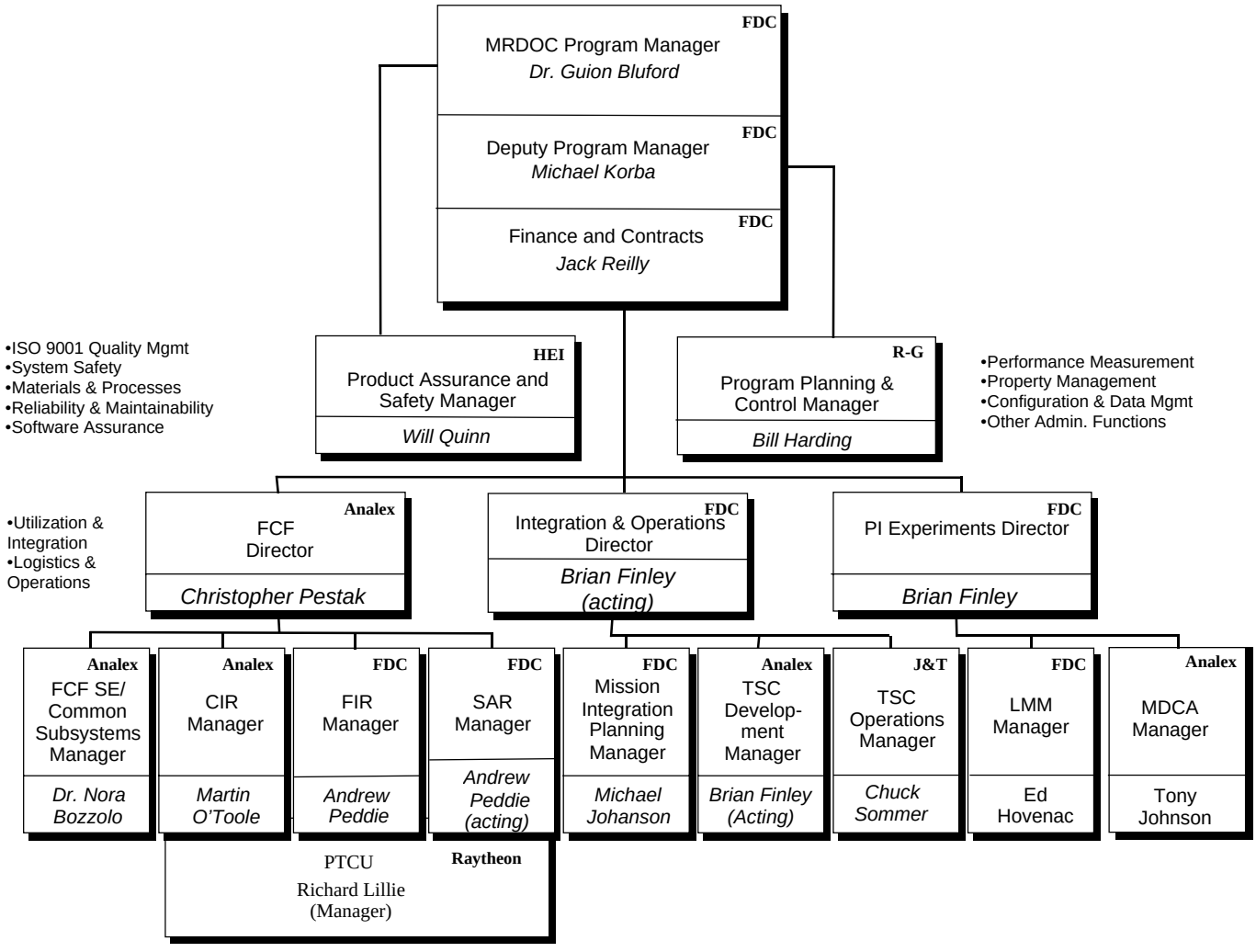


**Figure 2 Roles of Team Members in the MRDOC Program Organization**

| Team Member | MRDOC Role |
|---|---|
| FDC | Program Management, FCF FIR/SAR, TSC IT, mission integration, and fluids PI-specific experiments |
| Analex | FCF CIR, TSC, mission integration, combustion PI-specific experiments |
| J&T | TSC and mission operation, flight hardware fabrication, ground integration |
| HEI | Safety, reliability, and quality assurance |
| Raytheon | ISS training simulators and software development |
| Robbins-Gioia | Program planning, control and analysis |

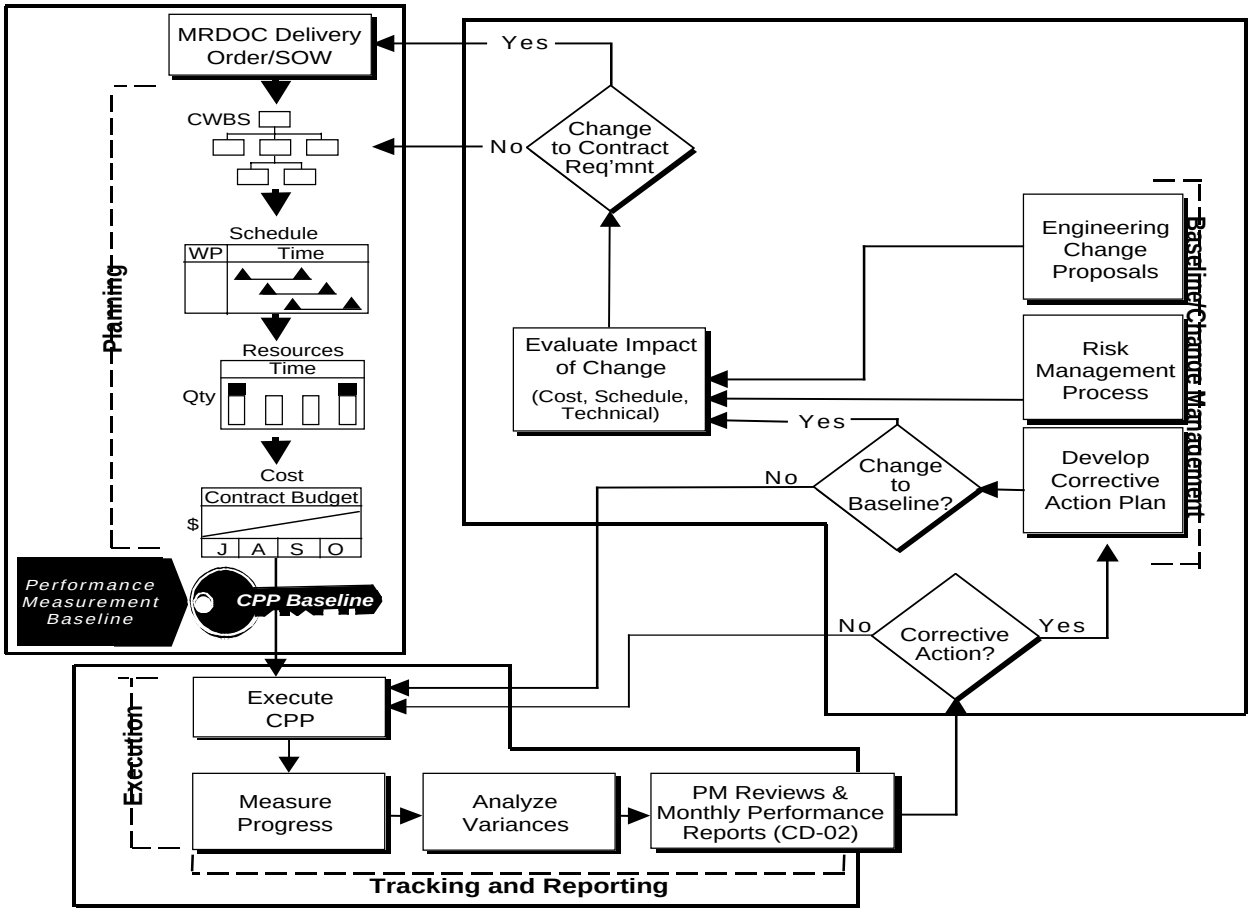
## 4.0 Performance Management Processes

Defined and repeatable business and program management processes are the cornerstone of the MRDOC Performance Measurement. The tailored processes ensure discipline and visibility in the following areas:

- Planning, scheduling, and budgeting work
- Statusing, reporting, tracking, and forecasting performance
- Financial and change management reporting.

Figure 3 is a summary view of the processes used to plan, baseline, and measure MRDOC performance.

**Figure 3 MRDOC Closed-Loop Performance Management Process**




MRDOC Team performance measurements are based on the FDC system of integrated cost and schedule planning, earned value management, risk management, and configuration management.

### 4.1 Integrated Cost and Schedule Planning

For the current Contractor Project Plans (CPPs) and for all future CPPs, the FDC Team decomposes the Contract Work Breakdown Structure (CWBS) to the appropriate level, based on the requirements of each project. The CWBS is expanded to lower levels for projects that are large/complex or are fixed price and require sufficient levels of decomposition for cost and schedule estimating and control. The lowest level of CWBS is assigned to a Work Package Lead authorized to perform the work package.

The work package becomes the basis for establishing the task activity network schedule, estimating resources, and establishing budgets. The work packages are:

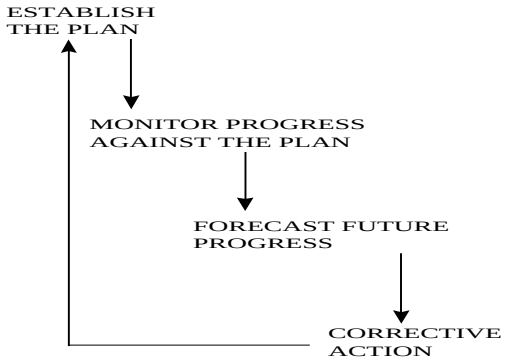
- Fully mapped and traceable to the lowest level of the task
- Sufficiently detailed to include activity identification and descriptions, activity precedence and relationships, and durations
- Mapped and traceable to in-process and end item deliverables, CDRLs, and progress payment schedules
- Appropriately resourced, identifying labor, material, and special requirements such as GFE, contractor-furnished equipment (CFE), and travel.

## 4.2 Earned Value Process

Meeting a project's cost and schedule goals is the significant measure of success. The ability to influence success requires the capability to identify and resolve problems before they reach criticality. Earned value management can be defined as a process that allows management to have visibility into cost and schedule progress of a program. This process has four steps, as follows:

ESTABLISH THE PLAN: Where were you supposed to be?
MONITOR PROGRESS AGAINST THE PLAN: Where are you?
FORECAST FUTURE PROGRESS: Are you going to get there?
CORRECTIVE ACTION: What do you do now?

**Figure 4 Performance Measurement Process**




### *4.2.1 Establish the Plan*

The plan is the Performance Measurement Baseline (PMB) against which progress will be measured. It is a time-phased budget allocating expenditures for various activities by time period. The first step is to decompose the program objectives into discrete, manageable work packages and activities by using a Work Breakdown Structure (WBS) to describe the program deliverables and the work to be accomplished. FDC, and our subcontractor team has prepared the MRDOC WBS down to where responsibility can be assigned and charges applied to a single cost (control) account. The WBS is constructed so each level includes all the elements required to complete the next higher level. In this manner, as the WBS is rolled-up to subsequently higher levels, costs can be accumulated. The MRDOC WBS is the basis for both the activity network (schedule) and the project resources (budget): hence a time-phased budget.

Using the MRDOC WBS as the foundation, we prepare an activity network (logic diagram) for each lower level element of the WBS by listing all the activities that must be accomplished to complete the WBS element. These activities are then logically sequenced, and relationships among the activities are determined. These relationships or constraints depict what activities must be performed sequentially and which can be performed in parallel. We design the activity network in such a manner that networks may be broken out by the various entities (Configuration Items (CIs), Exhibits, project milestones, etc.) so we can assign responsibility and track progress accordingly. We ensure that every project deliverable is specifically identified in the activity network so they are appropriately scheduled and monitored. Design of the network will include determining an estimated duration to

accomplish each activity. With a completed network and estimated durations, an automated project management tool (CAT II MIMS) is used to calculate the schedule.

Work packages constitute the basic building blocks used in planning, controlling, and measuring contract performance. A work package is a low level, detailed, short-span task or job assignment identified by the cost account manager as part of a cost (control) account. The MRDOC WBS is time-phased and includes estimated costs for each month during the life of the contract. The WBS is the performance measurement baseline for cost control. This is also known as the Budgeted Cost for Work Scheduled (BCWS).

#### *4.2.2 Monitor Progress Against The Plan*

With the MRDOC WBS in place as the Performance Measurement Baseline (PMB), work is authorized and initiated. This is the start of the performance data collection phase that is concerned with the accumulation of earned value derived from technical accomplishments and the actual incurred costs associated with the technical effort. The measurement of performance and identification of significant variances are the focus of this phase and will lead to analysis of performance indices, forecasts of impact, and recommendations for corrective action.

Current and cumulative values for scheduled work, work performed, and actual costs are tabulated to calculate variances on each WBS element. To collect actual costs that are incurred during the MRDOC, MIMS interfaces with the FDC Deltek cost accounting system to accumulate direct charges and compute the appropriate indirect charges on a periodic basis. We will measure progress using Budgeted Cost of Work Performed (BCWP), or Earned Value; and Actual Cost of Work Performed (ACWP). Techniques for claiming work depends on the size of the work package, duration, and complexity (see Table 5)

**Figure 5 Earned Value Performance Measurement Techniques**

| Technique | Application |
|---|---|
| 0/100 | Used for work packages that start and end in 1 month. |
| 50/50 | Used for work packages that start and end in 2 months. |
| Intermediate milestone | Used for work packages longer than 2 months in duration and when discrete, measurable milestones can be identified. |
| Percent complete | Used for work packages that are repetitive, definite quantity, and production oriented. |

The measurement and analysis of performance is primarily concerned with the identification of significant variances for schedule, cost, and variance at completion. This is performed at the program (project) level but may drill-down to tasks, subtasks, or activities as required. Comparison of current or cumulative values of Budgeted Cost of Work Performed (BCWP) with Budgeted Cost for Work Scheduled (BCWS) indicates the schedule status [Schedule Variance (SV) = BCWP - BCWS]. Comparison of the BCWP with the Actual Cost of Work Performed (ACWP) describes the cost status [Cost Variance (CV) = BCWP - ACWP]. When a variance is greater then five percent from the planned cost or schedule (BCWP) an analysis will be prepared providing:

1. Identification of the variance in dollars and percent
2. Root cause of the variance
3. Impact of the problem on the task, on other tasks, on the program
4. Detailed corrective action plan.

#### *4.2.3 Forecast Future Progress By Extrapolating Past Performance To Future Work*

A careful analysis of the cost and/or schedule variances occurring from the interaction of the three basic parameters (BCWS, BCWP, and ACWP) is the next step and will provide important information regarding program condition. Completion of these analyses on a monthly basis enables the tracking of program performance. The Cost Performance Index (CPI), [CPI = BCWP/ACWP], indicates the efficiency attained for the resources expended. The Schedule Performance Index (SPI), [ SPI = BCWP/BCWS], calculates the efficiency achieved regarding completion of scheduled work. In each case a 100% CPI and SPI would indicate that the project is on cost and on schedule as compared to the baseline.

Calculating Estimate At Completion (EAC) is a quick method to forecast what the program may really cost based on current data. However, an in-depth analysis should be conducted before taking management actions based solely on the Independent Estimate at Completion (IEAC). The various IEAC formulae all take the remaining work, divide it by a performance factor (say, CPI), and add to it the total actual cost incurred to date. MRDOC performance measurement techniques will provide needed insight into the status of the program and help forecast future performance based upon present trends.

#### *4.2.4 Corrective Action*

Regardless of the quality of the cost control system, problems may occur. The procedure for resolution is to identify the problem as early as possible, drive the problem back to its source, determine the likely impact(s), and develop alternatives for presentation to management.

Some typical problems that cause variances and require resolution are estimating errors, changing requirements, and changing economic conditions. The process for corrective action planning will:

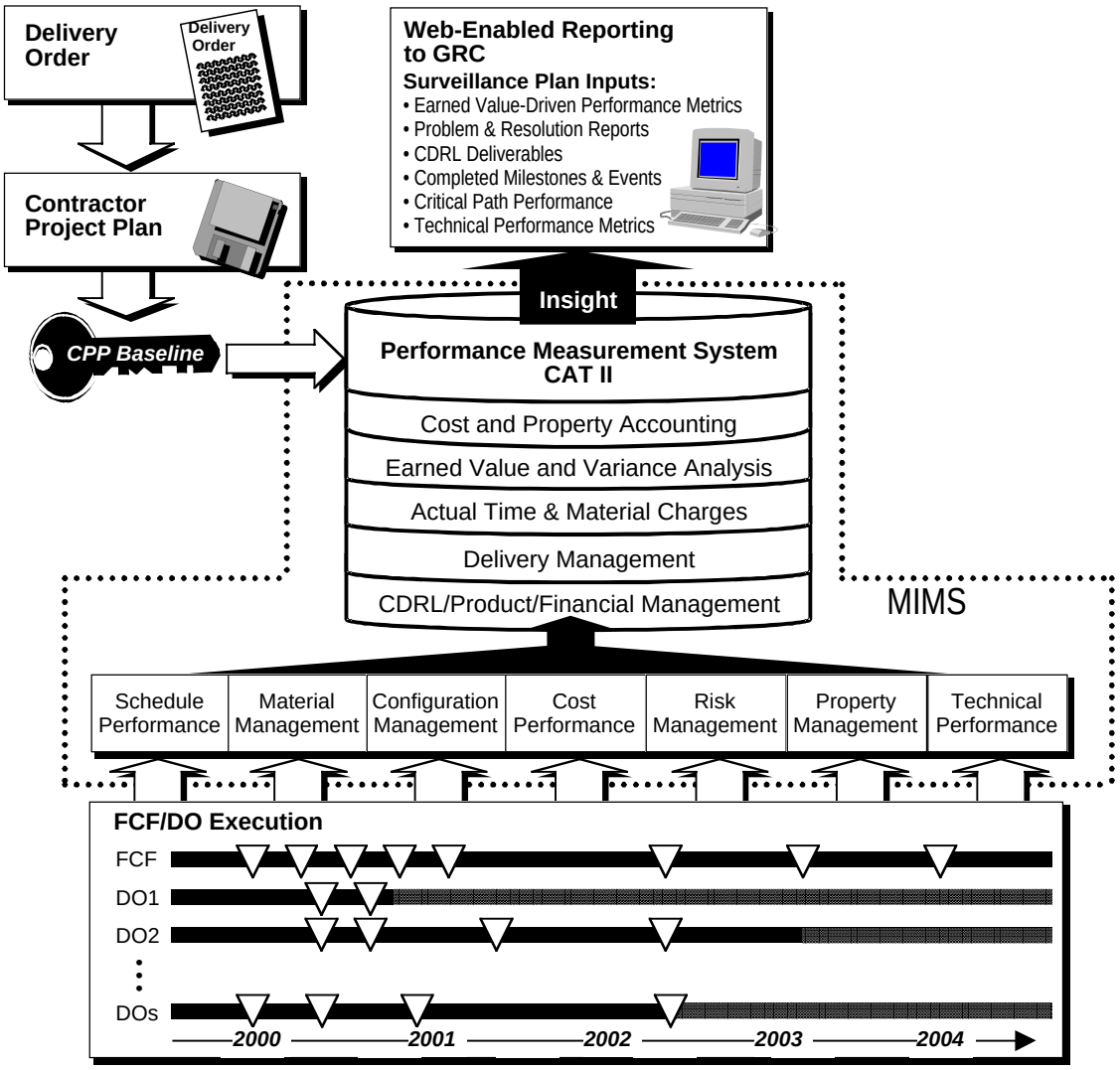
- Describe actions taken to minimize the risk
- Identify the individual/organization taking the required action
- Present a schedule for the plan with get-well dates
- If no corrective action is possible, explain why and discuss impact
- Monitor the corrective action plan and show results.

## 5.0 MRDOC Management Information System (MIMS)

The FDC MRDOC Team employs the widely used Deltek accounting software, a fully integrated, off-the-shelf, job order, accounting, purchasing and inventory. This system accumulates cost data and provides an integrated property management and material control capability. MRDOC performance measurement is fully integrated with Deltek's cost accounting data. This integration allows us to use cost control, tracking, and reporting processes as an integral part of MRDOC performance measurement system. The full integration of these systems and capabilities constitutes MIMS.

As shown in Figure 6 MIMS supports the MRDOC management processes and provides a surveillance interface to GRC. The MRDOC Team establishes the project baselines with the Contractor Project Plans (CPPs), and these form the basis of performance reporting for GRC surveillance/insight and support the management decision processes. Actual cost, schedule, and technical performance data are collected during FCF and DO execution, captured in the MIMS, and analyzed to obtain earned values, conduct variance analyses, and prepare performance metric reports. Reporting to GRC will be at the fourth level of the WBS or higher for Exhibit 1 and the third level or higher for Exhibit 2 and 3 delivery orders. Further details will be below this level within discrete work packages to meet management oversight needs.

**Figure 6 MRDOC Information Management System (MIMS)**




## 5.1 MIMS Information Engine

Because MRDOC is a large, complex program with tight cost, schedule, and performance requirements, FDC selected the Robbin's-Gioia CAT II project management tool to serve as the integrated repository of all MIMS cost, schedule, and technical performance information. Built around the CAT II capabilities (see Figure 7) the MIMS has been engineered to make the most of FDC's corporate financial and purchasing systems and, supplemented with industry commercial off-the-shelf (COTS) products, to provide MRDOC with a robust capability to plan, control, and monitor performance. The Government will have full and complete access to nonproprietary data and information maintained in MIMS via secure, Web-based access.

**Figure 7 CAT II Capabilities**

| Feature | Benefit |
|---|---|
| ***Earned Value*** | ***Enhanced decision information*** by fully integrating cost, schedule, and technical performance |
| ***Web Accessible*** | ***Improved information availability*** through convenience of desktop PC |
| ***Open Systems Architecture*** | ***Easy integration*** of disparate business and technical management systems |
| ***What-If Modeling*** | ***Optimize performance*** by assessing alternatives without affecting the baseline |
| ***Management Reporting*** | ***Focused management attention*** through exception-based reporting |

### 5.2 Web-based Access

A unique feature of MIMS is its interactive Web-accessible project reporting. This provides a timely, top-to-bottom view of project status, issues, and risk mitigation strategies. MIMS Web-accessible project reporting provides full "drill-down" capability to access the lowest level needed to uncover the root cause of issues. Performance reports (CD-02) and cost reports (CD-03) will be Web accessible 7 days a week, 24 hours a day. Access will be password protected and controlled to allow appropriate access depending on functional responsibility.

## 6.0 Performance Reports and Metrics

Cost, schedule, and technical performance is derived from measuring performance against baseline Contractor Project Plans (CPPs). The FDC Team will make management reports available to GRC via the MIMS Web site. Hardcopy reports will also be submitted monthly (CD-02 and CD-03). Figure 8 outlines the proposed table of contents for the MRDOC Monthly Report. Using CAT II's report writer, new reporting requirements will be defined, created, and included in CD-02 and CD-03 and made available on the MIMS Web site. All reports and graphs will focus management attention by highlighting tasks that are behind schedule, in jeopardy, over cost, or scheduled in the next 30, 60, or 90 days.

## Figure 8 MRDOC Monthly Report

**MRDOC MONTHLY REPORT**
NASA CONTRACT NAS 3-99155

1 Technical Performance

2 Near Term Activities

3 WBS Comments
- 3.1 Problems/Issues/Risks
- 3.2 Mitigation Strategies

APPENDICES

A. Schedules
- A1 Project Milestones
- A2 Major Concept Level Schedule
- A3 System Level
- A4 CDRLs on time
- A5 Planned hours versus actual by WBS and labor category
- A6 Work package status (plan/open/closed)

B. Earned Value Performance
- B1 Earned Value Performance Metrics
  (Cost Variance, Schedule Variance, Cost Index, Schedule Index, Estimate at Completion [EAC])
- B2 Cost Variance Report
  Explanation for variances exceeding 5% threshold
- B3 Schedule Variance Report
  Explanation for variances exceeding 5% threshold

C. Cost
- C1 Funds Status – obligations versus expenditures
- C2 NASA Form 533M/Q
- C3 Actual staffing versus plan

D. Technical Accomplishments
- D1 Top 5 Issues
- D2 Major program events next 30/60/90 days
- D3 Major accomplishments since last report
- D4 Risk status
- D5 Critical perform parameters (weight, size, power, etc.) maturity
- D6 Requirements stability
- D7 S/W lines of code
- D8 S/W units coded, reviewed, and tested
- D9 S/W problem reports time to close
- D10 S/W quality
- D11 CDRL rejections

E. Surveillance Plan
- E1 Subcontractors
- E2 Failure Review Board (FRB) Anomalies
- E3 Test Anomalies
- E4 Audit Results
- E5 Facilities and Test Equipment

F. Configuration Management
- F1 H/W problem reports open/closed
- F2 H/W defects
- F3 Deviation/waiver requests
- F4 Engineering Change Proposal (ECP) Status
- F5 Documentation – Drawings/Documents/Software
- F6 S/W problem reports open/closed

## 6.1 Metrics

Metrics focus management attention so solutions can be developed early enough to respond to problems, risks, or issues. MRDOC team corrective actions will be timely and technically manageable and optimize cost, schedule, and performance. Metrics driving the basis of estimate for each CPP will be baselined and measured. Historical performance will be factored in future DO CPPs. This is part of the closed loop ISO 9001 process to ensure that lessons learned and historical performance are integrated into estimating and planning processes.

### *6.1.1 Cost and Schedule Metrics*

Earned value is the basic tool to measure MRDOC cost, schedule, and technical performance. Current values for work scheduled and work performed will be tabulated by CAT II monthly. Actual costs will be compared to the tabulated costs and variances calculated. Performance will be measured using the budgeted cost of work performed (BCWP) against budgeted cost of work scheduled (BCWS) and actual cost of work performed (ACWP) to determine earned value. As appropriate, each work package will have associated technical performance metrics that measure actual progress toward meeting technical performance objectives. Work Package Leads are accountable for performance. The types of performance metrics the FDC Team will use to measure progress on MRDOC projects are set forth in Figure 9.

**Figure 9 Performance Metrics**

| | Metric | Definition | Source of Data | Computation Approach | Desired Outcome | Frequency of Reporting | Period of Measurement |
|---|---|---|---|---|---|---|---|
| Cost | Earned Value Performance | Report showing budgeted and actual work performed and scheduled; monthly and cumulative cost and schedule variances/indices; estimates at completion compared to the plan | FDC DELTEK (actual hours); MIMS (schedule status) | Compare budgeted hours/costs against expended hours/costs | Cost and schedule variances within 5% of budget; indices 100% or better efficiency | Monthly | As of end of preceding month and cumulative |
| Cost | Cost variance report (above/below threshold) | Report explaining WBS items outside 5% variance | FDC DELTEK (actual hours); MIMS (schedule status) | CV=BCWP-ACWP | Cost variances within 5% of budget | Monthly | As of end of preceding month and cumulative |
| Cost | Actual Staffing vs Plan | Histogram showing actual and planned staffing by month | FDC DELTEK (Project Plan) | Compare staff against staffing and work projections | Staffing inline with projections | Semi-Monthly | As of preparation date and cumulative |
| Cost | Funds Status - obligations vs expenditures | Report comparing monthly obligations with expenditures by WBS item | FDC DELTEK (WBS budget) | Compare actual expenditures with time phased WBS budget | Expenditures inline with budget | Monthly | As of end of preceding month |
| Cost | NASA Fm 533M/Q | Report showing actuals, planned, cum, and final est hours/costs in NASA 533 format | FDC DELTEK (WBS budget) | Compute actual, planned, and estimated final hours/costs | Hours/costs inline with plan | Monthly | As of end of preceding month and cumulative |
| Schedule | Baselined Project Milestone Schedule | Schedule Gantt showing project baseline milestones and current milestone status | MIMS (schedule status - Project Manager) | Milestones precedenced and maintained in master schedule | Maintain baseline milestone schedule | Monthly | As of end of preceding month |
| Schedule | Project Major Concept Schedule | Schedule Gantt rollup showing level 3 WBS activities | MIMS (schedule analysis) | MIMS master schedule rolled up to level 3 WBS | Maintain WBS level 3 activities within schedule variance limits | Monthly | As of end of preceding month |

| | Metric | Definition | Source of Data | Computation Approach | Desired Outcome | Frequency of Reporting | Period of Measurement |
|---|---|---|---|---|---|---|---|
| Schedule | Project System Level Schedule | Schedule Gantt to the WBS work package level | MIMS (schedule status - Functional Managers) | MIMS master schedule - Precedence Diagram Method (PDM) analysis | Maintain schedule within variance limits | Monthly | As of end of preceding month |
| | Schedule Network | Precedence Diagram Method (PDM) chart to the work package level | MIMS (schedule status - Functional Managers) | MIMS master schedule - Precedence Diagram Method (PDM) analysis | Maintain schedule within variance limits | As required | As of preparation date |
| | CDRLs on time | Histogram showing the number of CDRLs due and those delivered on time | Data Management | Track CDRL due dates and delivery dates | 100% on time | Monthly | As of end of preceding month and cumulative |
| | Planned hours vrs actual by WBS and labor cat | 533M Report | FDC DELTEK (WBS budget) | Compute actual, planned, and estimated final hours/costs | Hours/costs inline with plan | Semi-Monthly | As of preparation date and cumulative |
| | Work Package Status (plan/open/closed) | Schedule report showing the planned/actual starts and finish dates for each cost coded WBS | MIMS (schedule status - Functional Managers) | MIMS master schedule - Precedence Diagram Method (PDM) analysis | Manage work package schedule to maintain schedule within variances | Monthly | As of end of preceding month |
| | Schedule variance report (above threshold) | Report explaining WBS level 3 items exceeding 5% schedule variance | FDC DELTEK (actual hours); MIMS (schedule status) | SV=BCWP-BCWS | Schedule variances within 5% of baseline | Monthly | As of end of preceding month and cumulative |
| Technical Performance | Top 5 Issues | Report highlighting the top five issues at the project level | Project Manager | Project Manager estimation | Issue resolution | Monthly | As of end reporting period |
| | Major accomplishments since last report | Report highlighting major accomplishments at the project level for the reporting period | Project Manager | Project Manager estimation | Technical/schedule success | Monthly | As of end reporting period |
| | Risk Status | Risk Radar Report showing current risks and assessing the risk impact on the project. | Project Manager / Functional Managers | Identify risks and track status through elimination, avoidance, or mitigation | Identify major risks and maintain the lowest level of project risk possible | Monthly | As of end of preceding month and cumulative |
| | Critical performance parameters (weight, size, power, etc.) maturity | Report showing current engineering values versus ICD values. | Package lead provide values as parts are fabricated or purchased. | Compare ICD values with current engineering values. | Identify performance parameters and initiate control techniques | Monthly Quarterly and at major milestone reviews. | As of end of preceding reporting period and cumulative |
| | S/W Lines of Code | Source Lines of Code identified as Comments and Executable | Engineering Model and Flight Code | Per Reporting Period<br><br>Cumulative Totals | Tracking of Software Lines of Code Completed | Monthly | Engineering Model Development through Unit Test |
| | S/W units coded, reviewed, & tested | Engineering Model and Flight Code units identified during FCF Software CDR | Engineering Model and Flight Code units identified during FCF Software CDR | Cumulative Percent Complete for units coded, formally inspected, and tested | Tracking of Percent Complete Actuals to Planned | Monthly | Engineering Model Development through Unit Test |
| | S/W problem reports time to close | Software Problem Reports identified and tracked after formal baselining of software | Software Problem Reporting and Corrective Action System | Reports closed within 7 Days, 14 Days, 21 Days, and 30 Days. Action Plan for those exceeding 30 days | Timely Closure of all identified Software Problem Reports | Monthly | Formal Baseline of Flight Code until Delivery |

| | Metric | Definition | Source of Data | Computation Approach | Desired Outcome | Frequency of Reporting | Period of Measurement |
|---|---|---|---|---|---|---|---|
| **Technical Performance** | S/W quality | Software Quality Metrics as identified by SEI Capability Maturity Model (CMM) Level 3 | Engineering Model and Flight Code | Per Reporting Period | Tracking of Software Quality per identified Software Metrics | Monthly | Life Cycle of Software Development |
| | Major program events next 30/60/90 days | Report type (complexity) and number of events over period. | Schedule | Calculate percentage of effort used to prepare for event as compared to hardware preparation. | Use information to identify staffing, schedule, and cost risks. | Monthly | As of end of preceding month and cumulative |
| | CDRL rejections | Report of number of rejections and type of reasons for rejection. | MIMS will track CDRL rejections and type based on Customer feed back. | Compute percentage of each type of rejection (editorial, format, engineering content, etc) | Correct approach to CDRL sign off and submission, and to plan staffing/schedule. | Monthly | As of end of preceding month and cumulative |
| | H/W problem reports open/closed | Report number of problem issues associated with the build of hardware and software | Configuration Status Accounting System (CSAS) | Identify problem reports pending disposition (open) and resolved (closed) | Ensure timely resolution of problem issues | Monthly | As of end of preceding month and cumulative |
| | H/W defects | Report the number of defects, type of defects, and disposition for each subassembly. | Configuration Status Accounting System (CSAS) | Track the defect rate and type of disposition. | Identify problem areas in fabrication and design. Identify schedule, cost and performance risk. | Monthly | As of end of preceding month and cumulative |
| **Configuration Management** | Request for Deviation/Waivers (RDW) | Report number of Deviations and waivers generated and those accepted. | Configuration Status Accounting System (CSAS) | Track open/closed, corrective action, and status | Determine causes associated with the generation of RDWs. | Monthly | As of end of preceding month and cumulative |
| | Engineering Change Proposals (ECPs) | Report number ECPs generated and disposition | Configuration Status Accounting System (CSAS) | Track ECP status and disposition | Determine trends in generating ECPs | Monthly | As of end of preceding month and cumulative |
| | Documentation – Drawings/ Documents/ Software | Report status of engineering data in review, released, and changed | Configuration Status Accounting System (CSAS) | Track status of all documentation issued | Ensure documentation progresses with schedule | Monthly | As of end of preceding month and cumulative |
| **Surveillance Plan** | Logistics Milestone Plan | Planned vs. actual for acquisition activities. Critical parts tracking – actual delivery vs need date | DELTEK / Bill of Material | Analyze collected and tracked data | Ordering and deliveries are driven by and meet integrated schedule | Monthly | As of end of preceding month and cumulative |
| | Subcontractors | Track surveys, inspections, audits, deliveries, assessments, and concerns/issues/problems | FDC Contracting | Analyze collected and tracked data | Insure subcontractors meet program responsibilities | Monthly | As of end reporting period |
| | Failure Review Board (FRB) Anomalies | Track FRB actions by component/subsystem. Track open/closed and time to close reports | Quality Assurance | Compute open/closure rates and average time to closure | Provide analyzed failure data and process improvement to reduce failure rates | Monthly | As of end of preceding month and cumulative |

| Metric | Definition | Source of Data | Computation Approach | Desired Outcome | Frequency of Reporting | Period of Measurement |
|---|---|---|---|---|---|---|
| Test Anomalies | Track test process times, generation of reports and corrective actions | Engineering Test/Quality Assurance | Collect and analyze quantity, times, cause and corrective actions of anomalies | Provide test anomaly data to improve design and processes | Monthly | As of end of preceding month and cumulative |
| Audit Results | Track audit findings. Develop trends relating to open/closed items, time to closure. Track corrective actions. | Program Manager | Track data and develop analysis report | Time closure and affective corrective actions | Monthly | As of end reporting period |
| Facilities and Test Equipment | Report status of facilities, test equipment, tools, and support equipment. | Functional and program management | Track data and develop analysis report | Prevent delays related to facilities and equipment | Monthly | As of end reporting period |

### *6.1.2 Technical Performance Metrics*

MRDOC Engineering Management will assess requirement volatility, design stability, and plan verses actual outcome metrics to insure the project is on schedule and to plan resources. Requirements volatility will be assessed by tracking change orders that affect requirements. Engineering management and Configuration Management Team will evaluate change orders to determine the change rate, schedule impact, and cost of change requirements affecting the project. Design stability will be assessed by measuring the number and type of changes made to baseline drawings. Subsystem managers will evaluate the effectiveness of the revision process and assess the rate of drawing change. Plan verses actual outcome will be assessed by tracking specifications released and tests completed. The Software Team will provide the lines of code released and accepted. Engineering metrics will be reported monthly and at Life-Cycle reviews.

### *6.1.3 Configuration Management Metrics*

Configuration Management (CM) establishes and defines the responsibilities and processes for controlling project requirements and interfaces. Using functional (established at the Preliminary Design Review), allocated (established prior to the Critical Design Review), and production (established prior to integration and test) baselines CM tracks changes to drawings, specifications, technical documentation, and software. Specific CM metrics reported monthly to MRDOC executive and functional managers include: hardware problem reports open/close; hardware defects reported/resolved; Requests for Deviation/Waivers (RDWs) open/closed; Engineering Change Proposals (ECPs) pending/approved; and documentation status.

## 6.2 Cost and Progress Tracking, Controlling, and Reporting

The MRDOC Team will monitor and control performance by using a uniform performance measurement process for all CPPs. This includes:

- Timely and regular status collection cycles
- Scheduled and ad hoc management reviews
- Integrated earned value performance measurement
- Proactive what-if modeling.

Once baselined, the CPP is the basis for measuring cost, schedule, and technical performance. All Work Package Managers will update the status of schedule performance every two weeks. This includes identifying actual starts, actual finishes, and percent complete for each ongoing activity. Schedule performance will be summarized and

performance will be measured against the baseline. Work Package Managers will also be provided information on actual versus planned labor hours every two weeks from MIMS. Labor hour tracking is the fundamental tool used to control cost. Gantt charts, developed and produced by CAT II, will depict schedule performance and be used as a management tool in weekly DO Project Manager's meetings along with the labor hour reports. Risk identification is an ongoing process and the responsibility of each member of the FDC Team. DO Project Managers will review, assess, and prioritize risks weekly. Risks that merit further analyses will be assigned to a Program Planning and Control Facilitator to develop appropriate risk mitigation strategies. Costs will be collected and summarized monthly. This tracking process fully captures FDC labor, subcontractor labor, ODCs and material and integrates schedule performance.

Each Work Package Manager will use the integrated cost, schedule, and technical performance earned value reports and analyses to redirect resources, staff, and expertise to optimize performance. Each manager will have a Program Planning and Control Facilitator to assist in performing cost and scheduling what-if modeling, which ensures that performance against CPP baselines remains realistic and achievable. The approach is to manage performance toward a specific goal, measure progress against the baseline, and adjust performance to ensure success.

### 6.3 Problem Solving and Resolution

Problem identification and analysis are performed at the project level and at the level of the work packages, tasks, or subtasks as required. When problems that affect performance are identified following a 2-week labor cycle or a monthly integrated cost and schedule reporting cycle, a Variance Analysis Report is automatically generated and e-mailed to the appropriate Work Package Lead. The Work Package Lead has one week to:

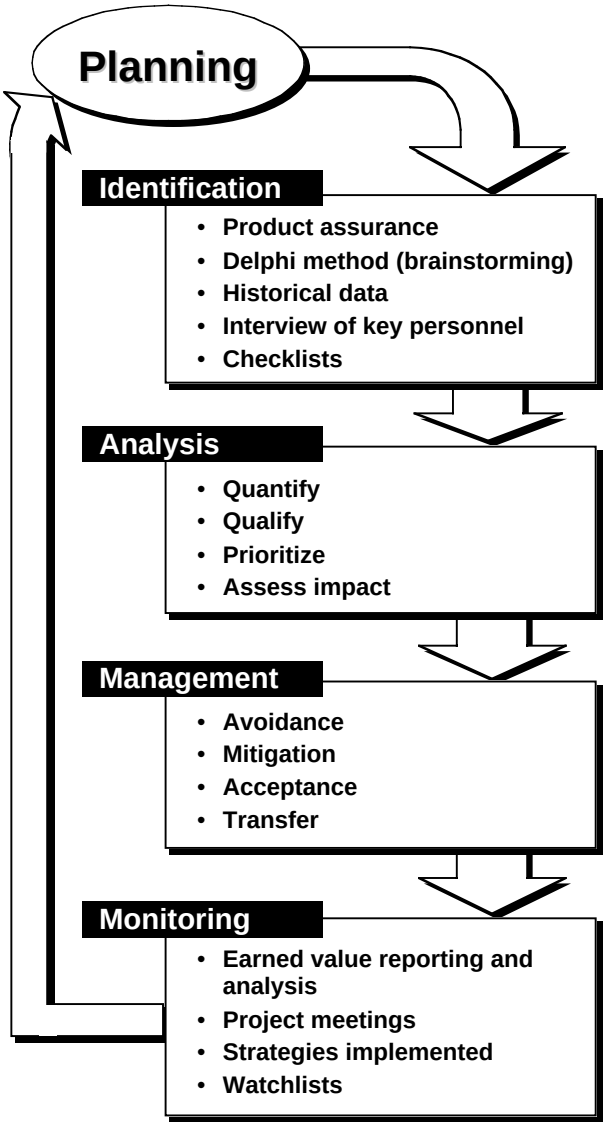
- Identify the root cause of the variance
- Assess the impact of the problem on the task
- Create a detailed corrective action plan.

The Program Planning and Control Facilitator will assist each Work Package Lead in preparing responses, as needed. The facilitator will also make projections of the impact of task variances on other tasks and the project as a whole. These corrective action plans will be updated as appropriate and tracked through closure. The Work Package Lead's assessments and facilitator's impact projections will be forwarded, via MIMS, to the appropriate Project Manager, Director, Program Manager, and Deputy Program Manager and will form the basis of their weekly technical reviews.

## 7.0 Risk Management

MRDOC risk management involves two fundamental processes. The first process is embedded in early project planning efforts. The second process provides early identification of problems throughout the life of each DO. Product assurance plays a vital role in identifying those risks not immediately identified at project initiation. Resolution of an emergent problem could be as simple as allocation of management reserve or as complex as a major replanning. Some typical emergent risks are estimating errors, changing requirements, dynamic schedules, and technical complexity. These potential risks are addressed during the preparation of the Contractor Project Plans (CPPs) and mitigated by implementing the MRDOC risk management methodology. Figure 10 describes the risk management process.

**Figure 10 MRDOC Risk Management**




## 7.1 Early Project Planning Risk Managment

**Planning**. Risk planning begins with the development of technical and cost proposals.

**Identification**. During preparation of the CPPs, risk areas are identified using senior management reviews, "what-if" exercises, product assurance, project documentation, and subject matter experts. From this information, a list of probable risk events is developed.

**Analysis**. Next the risks are quantified and qualified as much as possible. Each risk is evaluated for probability of occurrence and potential impact in terms of cost, schedule, and technical performance. Where quantification is not possible, a rough magnitude is assigned to assist prioritizing risk events. Also considered are GRC and NASA priorities. Occurrence and consequence are each assigned a rating of low, moderate, or high.

**Management**. Three basic risk response strategies are employed in the management of identified MRDOC risks: avoidance, mitigation, or acceptance. Generally we will accept the consequences of low-risk events, eliminate the risk inducing cause for high-risk events, and reduce moderate risk by minimizing the probability of occurrence, minimizing the magnitude of the impact, or sharing the consequences with another stakeholder. In no case will risks be transferred to the Government.

**Monitoring**. As MRDOC is implemented, the MRDOC Team will watch for and respond to emergent risks not identified in the planning process. Project Managers and Work Package Leads are responsible for implementing corrective action. Initial contingency planning is focused on those remaining low-risk events that have not been eliminated, avoided, or mitigated.

### 7.2 Life-Cycle Risk Management

Risk management is a continuous, closed-loop process. As project tasks and subtasks are completed, lessons learned are applied to the risk management process to reduce the risk associated with remaining project events. The MRDOC Team employs a risk management facilitator in Program Planning and Control to make maximum use of lessons learned. The MRDOC Team will manage emergent risk by taking the following actions:

- Identify potential risk events and assess the probability of occurrence and the severity of the consequences
- Identity the organization and individual responsible for corrective action
- Prepare a corrective action plan and schedule, as necessary
- Implement corrective action
- Monitor and report the status of corrective action until the risk is mitigated.

### 7.3 Risk Radar System

The FDC MRDOC Team has chosen the Risk Radar system to identify, prioritize, and communicate project risks. Risk Radar provides standard database functions to add and delete risks, together with specialized functions for prioritizing and retiring project risks. A set of standard short- and long-form reports and viewgraphs can be generated to share project risk information with all members of the MRDOC team. The number of risks in each probability/impact category by time frame can be displayed graphically, allowing the user to visualize risk priorities and uncover increasing levels of detail on specific risks.

# Appendix A

**Terms and Definitions**

| | |
|---|---|
| 1. | *Activity* is a unit of work with an identifiable start and end point, consumes resources and produces an output. It is the lowest level of detail that is tracked within the planning and control system. Activity is interchangeable with task. It is at the activity or task level that dependencies and durations are used to calculate plan dates. |
| 2. | *Activity Network* is a logically sequenced or constrained listing of the work planned for the MRDOC Project at the lowest level of detail. The term activity network is interchangeable with System Level Schedule. The Summary Master Schedule represents a high level roll-up of detail planning. |
| 3. | *Actual Cost of Work Performed (ACWP)* is the cost actually incurred to accomplish the work performed within a given time period. For all direct labor, material and ODC costs are identified in the Deltek financial accounting system and downloaded directly into the CAT II MIMS. |
| 4. | *Analex* is Analex Corporation. |
| 5. | *Apportioned Effort* means an effort that by itself is not readily divisible into short-span work packages but which is related in direct proportion to the measured effort. |
| 6. | *Budget at Completion (BAC)* represents the total budgeted resources associated with a given scope of work. The BAC is equal to the sum of the time-phased budgets (BCWS) for all work packages and planning packages along with management reserve for that given scope of work. The terms Total Allocated Budget (TAB) and Budget At Completion are interchangeable. |
| 7. | *Budgeted Cost of Work Performed (BCWP)* is the sum of the budgets for all completed work packages and completed portions of open work packages, plus the applicable portion of the budgets for level of effort and apportioned effort. It is the budgeted value of the work completed for a given period of time. Also known as Earned Value (EV). BCWP is computed at the work package level and rolled up to the project level. |
| 8. | *Budgeted Cost of Work Scheduled (BCWS)* is the sum of the budgets for all work packages, planning packages, etc., scheduled to be accomplished (including in-process work packages), plus the amount of level of effort and apportioned effort to be accomplished within a given time period. The sum of the BCWS for a task is the BAC for the task. BCWS is the time phased baseline plan for performance measurement. Also known as Planned Value (PV). BCWS is computed at the work package level and rolled up to the project level. |
| 9. | *Capability Maturity Model (CMM)* is a model for judging the maturity of the software processes of an organization and for identifying the key practices that are required to increase the maturity of these processes. |
| 10. | *CAT II* means Control and Analysis Tool. It is a software package used to produce some of the individual reports that comprise the monthly Performance Measurement Report. |
| 11. | *Commercial Off The Shelf (COTS)* is material that is readily available to purchase through normal business avenues. It is not material that is custom built. |
| 12. | *Constraint or dependency* is the relationship one task has on another. It is by identifying dependencies between tasks, that Critical Path Method analysis is conducted to determine the status of the MRDOC plans. |
| 13. | *Contract Data Requirement List (CDRL)* is a compilation of all data requirements that FDC is obligated to submit to NASA. |
| 14. | *Contract Work Breakdown Structure* is the WBS for the entire contract. There is a WBS for each Delivery Order. |
| 15. | *Contractor Project Plan (CPP)* is complete definition of the work to be performed by the contractor with schedules, deliverables, documents, plans, costs, etc. |

| | |
|---|---|
| 16. | *Cost Account* is the level of the Work Breakdown Structure (WBS) at which exists organizational responsibility for individual WBS elements. It is the point where the Contract Statement of Work, Schedule and Budget are integrated. Comparison of BCWP with BCWS and with ACWP is made at the cost account level. Cost Accounts consist of an aggregation of work packages and planning packages which is the responsibility of a single organization. Managerial authority and responsibility for corrective action exists at this point making the Cost Account a key management control point. |
| 17. | *Cost Performance Index (CPI)* is = BCWP/ACWP: The CPI is also known as the Performance Factor. This represents actual cost efficiency. Greater than 1 is favorable while less than 1 indicates cost overruns. |
| 18. | *Cost Variance (CV)* is the difference between the BCWP and ACWP. This is calculated both monthly and cumulatively per the following formula, Cost Variance (CV) = BCWP - ACWP. A positive variance is favorable and indicates cost underruns whereas a negative cost variance indicates cost overruns. Cost Variance can also be expressed in a percentage per the following formula, Cost Variance (CV) % = (BCWP - ACWP) / BCWP) x 100% |
| 19. | *Critical Path Method (CPM)* is a method for identification and assessment of schedule priorities and impacts. It identifies the contiguous path that has no float or allowance for delay in completion of an activity. A delay of any activity on the critical path is an indication that the completion of the project will be delayed. |
| 20. | *Deltek* is the FDC financial accounting package where all charges are initially collected and reconciled prior to transfer to the CAT II MIMS system. |
| 21. | *DID* is Data Item Deliverable, an item on the Contract Data Requirements List. It describes in detail the content and format of the deliverable. |
| 22. | *Direct charge* is any labor or material that is charged directly and entirely to a work package level effort. Typically engineering and technical personnel are direct charges. |
| 23. | *Earned Value Management (EVM)* is a methodology by which an integrated system uses earned value to measure progress objectively. |
| 24. | *Earned value* see Budgeted Cost of Work Performed. |
| 25. | *Estimate at Completion (EAC)* represents the forecasted total cost at completion for a given task. The EAC equals the actual costs incurred to date (ACWP) plus the estimated required resources to complete (ETC) the remaining work scope. The terms Estimate at Completion (EAC) and Latest Revised Estimate (LRE) are used interchangeably. EAC is computed at the work package level and rolled up to the project level. |
| 26. | *Estimate to Complete (ETC)* is The ETC represents the estimated resource requirements to complete a given task. Cost Account Managers based on performance to date, knowledgeable projections of future performance, and the forecasted economic environment prepare ETCs. ETC is computed at the work package level and rolled up to the project level. |
| 27. | *FDC* is Federal Data Corporation. |
| 28. | *GRC* is the NASA Glenn Research Center in Cleveland, OH. |
| 29. | *GSFC* is the NASA Goddard Space Flight Center in Greenbelt, MD. |
| 30. | *HEI* is Hernandez Engineering, Inc. |
| 31. | *Independent Estimate at Completion (IEAC)* represents a mathematical calculation of the estimate at completion based on the existing cost efficiency continuing through to completion of the task. It is used independently to validate existing management projections. IEAC = BAC/CPI |

| | |
|---|---|
| 32. | *Indirect charge* is any labor or material that is not charged directly and entirely to a work package level effort. Typically support personnel and management are indirect charges. |
| 33. | *Interface Control Document (ICD)* is a document that describes a hardware or a software item's physical characteristics that become the engineering basis for constructing or modifying compatible supporting equipment. |
| 34. | *J&T* is Jackson and Tull Chartered Engineers |
| 35. | *JSC* is the NASA Johnson Space Center in Houston, TX. |
| 36. | *KSC* is the NASA Kennedy Space Center in Cape Canaveral, FL. |
| 37. | *Logic Diagram* is a graphical presentation of an Activity Network. See Precedence Diagram Method. |
| 38. | *Major Concept Level Schedule* is the high level rollup of the System Level Schedule. |
| 39. | *Microgravity Research, Development and Operations Contract (MRDOC)* is the name of the project covered by this contract. |
| 40. | *MIMS* means MRDOC Information Management System. It consists of the CAT II application and the interfaces to the Deltek financial system, Microsoft Project, Risk Radar and any other systems used within the FDC MRDOC project. |
| 41. | *MSFC* is the NASA Marshal Space Flight Center in Huntsville, AL. |
| 42. | *Percent Complete* = (BCWPcum /BAC) x 100: This represents the physical percentage complete of a task in relation to the total scope of work for that task. |
| 43. | *Percent schedule complete* = (BCWScum / BAC) x 100: This represents the percentage of work scheduled to date. |
| 44. | *Performance Measurement Baseline (PMB)* is the time-phased budget plan against which contract performance is measured. The PMB represents the sum of the budgets for cost accounts, higher level CWBS elements, and undistributed budgets spread over the duration of the approved Contractor Work Plan Schedule. It equals the Contract Budget Base less Management Reserve |
| 45. | *Performance Measurement Metric* is a specific performance measurement. In this case cost and schedule status, technical accomplishments, risk status, etc. |
| 46. | *Performance Measurement Plan (PMP)* is this document of which this is the glossary. |
| 47. | *Performance Measurement Report* is the collection of tabular and graphic displays of the performance metrics that is collected. They include details of labor hours used and material procured by WBS with summaries of the data and the analysis performed, technical accomplishments, risk analysis, etc. |
| 48. | *Precedence Diagram Method (PDM)* is one of the two methods of representing project as networks, in which the activities are represented by nodes and the relationships between them by lines. It is the method that The MRDOC project will use. |
| 49. | *Project Milestone Schedule* is the list of significant accomplishments and deliverables constrained to the work packages that lead to the accomplishment or deliverable. |
| 50. | *Project Resources* (budget) are anything for which costs are incurred during the performance of the work on the contract. This includes labor, material and ODCs. |
| 51. | *Raytheon* is Raytheon training Operations. |
| 52. | *R-G* is Robbins-Gioia, Inc. |
| 53. | *Risk Radar* is a software tool used to track risk issues and their resolution. It is a Microsoft Access application and report. |
| 54. | *Schedule Performance Index (SPI)* is BCWP/BCWS: This represents the relative efficiency of schedule accomplishment. Greater than 1 indicates ahead of schedule while less than 1 indicates schedule |

| | |
|---|---|
| | slippage |
| 55. | *Schedule Variance (SV)* is the difference between BCWP and BCWS. This is calculated both monthly and cumulatively per the following formula, Schedule Variance (SV) = BCWP - BCWS.<br>A positive schedule variance indicates an ahead of schedule position, whereas a negative schedule variance indicates schedule slippage. Schedule Variance can also be expressed in a percentage per the following formula, Schedule Variance (SV)% = (BCWP - BCWS) / BCWS) x 100 |
| 56. | *System Level Schedule* is the lowest level of planning for work packages. See Activity Network. |
| 57. | *To Complete Performance Index* (TCPI = (BAC - BCWP) / (EAC - ACWP): Also known as the verification index. This is a ratio of work remaining against resources remaining to complete the work. This represents the cost efficiency that must be achieved to complete the budgeted scope within the current cost projection (EAC). |
| 58. | *Variance Analysis Report* is a narrative report that is required when a WBS element has a cost or schedule variance of more than 5% of the planned value. This includes cost underrun and ahead of schedule as well as cost overrun and behind schedule. |
| 59. | *Variance at Completion (VAC)* represents the forecasted cost underrun or overrun at completion for a given task. The VAC is equal to the Budget at Completion (BAC) minus the Estimate at Completion (EAC), or BAC-EAC = VAC. A positive VAC is favorable and indicates the effort will be completed at lower total cost (ACWP) than budgeted (BAC). Conversely a negative VAC is unfavorable and indicates actual costs to complete the effort will exceed the budget. |
| 60. | *What-if modeling* is a technique whereby managers are able to take a copy of a baselined schedule and change resources and durations to see what impact these changes will have on the cost and schedule. It is used to assist in determining what is necessary to mitigate a cost or schedule problem. |
| 61. | *Work Breakdown Structure (WBS)* is a product-oriented family tree of hardware, software, services and other work tasks which organizes, displays and defines the product to be developed and/or produced and relates the elements of the work to be accomplished to each other and the end product(s). |
| 62. | *Work Package* is the subdivision of a Cost Account and constitutes the basic building blocks for authorizing, measuring and controlling contract performance. A work package represents a detailed task and describes the work to be accomplished by a specific organization. In most cases, Work Packages are the levels of the WBS where BCWS, BCWP, ACWP, EAC and BAC are first compared and variances are generated. |